PCAN-Router DR

Universal CAN Converter in DIN Rail Plastic Casing

User Manual

Document version 2.0.0 (2014-03-31)

PEAK System

Products taken into account

Product Name	Model	Part number
PCAN-Router DR	Industry	IPEH-002213

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1 Introduction

The PCAN-Router DR has two High-speed CAN channels. Their bit rate is adjusted with a rotary switch on the device front. The module forwards the message traffic bi-directionally one on one between both connected CAN busses.

The ports of the device are isolated against each other and against the power supply with at least 500 V. Furthermore, CAN 1 has a separation voltage of up to 5 kV conforming with IEC 60601-1. With its DIN rail casing and the support of the extended temperature range, the module is suitable for use in an industrial environment.

As well as the PCAN-Router in the aluminum casing, the PCAN-Router DR can be freely programmed. A corresponding development package is included in the scope of supply.

1.1 Properties at a Glance

- Microcontroller of the NXP LPC21 series (16/32-bit ARM CPU)
- External 32-kByte EEPROM
- 2 High-speed CAN channels (ISO 11898-2)
- NXP CAN transceiver PCA82C251
- Bit rates from 5 kbit/s up to 1 Mbit/s, set with rotary switch
- Restart of the device with a reset button
- Switchable termination for each CAN channel
- Status indication via LEDs for the module status, both CAN channels, and the power supply
- Connections for CAN, RS-232, and power supply via 4-pole screw-terminal strips (Phoenix)

- CAN 1 is isolated up to 5 kV against CAN 2, RS-232, and the power supply (compliant with IEC 60601-1)
- CAN 2 and RS-232 are isolated with 500 V against each other and against the power supply
- Plastic casing (width: 22.5 mm) for mounting on a DIN rail (IEC 60715 TH35)
- Supply voltage from 8 to 30 V
- Extended operating temperature range of -40 to 85 °C (-40 to 185 °F)
- RS-232 connector for serial data transfer (reserved for future use)

1.2 Prerequisites for Operation

- Power supply in the range of 8 to 30 V DC

1.3 Scope of Supply

- PCAN-Router DR in DIN rail plastic casing
- Mating connectors (Phoenix, type: MSTB 2,5/4-ST BK) for both CAN channels, RS-232, and power supply
- Windows development software (Yagarto GNU ARM toolchain, flash program)
- DVD with library, programming examples, and manual in PDF format

2 Connectors

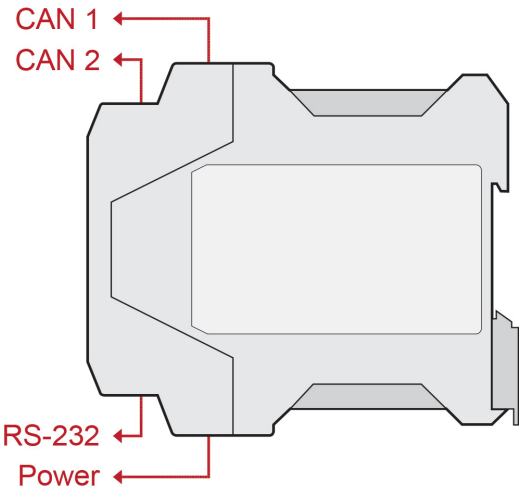


Figure 1: Position of the connectors

2.1 CAN 1/CAN 2

The CAN connectors are located on the upper side of the casing.

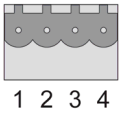


Figure 2: Pin assignment connectors CAN 1 and CAN 2

Pin	Assignment
1	CAN-High
2	CAN-Low
3	CAN-GND
4	CAN-Shield

2.2 RS-232

The RS-232 connector is located on the lower side of the casing.

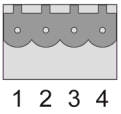


Figure 3: Pin assignment RS-232 connector

Pin	Assignment
1	GND
2	RxD
3	not connected
4	TxD

2.3 Power (Voltage Supply)

The connection for the power supply is located on the lower side of the casing.

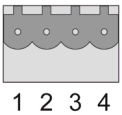


Figure 4: Pin assignment power connector

Pin	Assignment
1	GND
2	not connected
3	Vbat (8 - 30 V)
4	Shield

2.4 Galvanic Isolation of the Connections

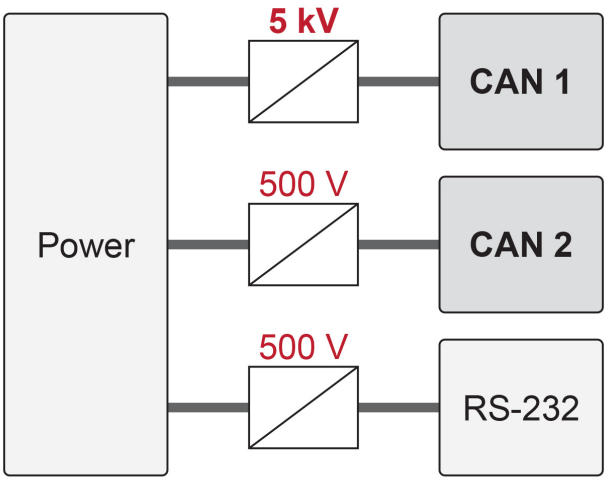


Figure 5: Galvanic isolation

The ports of the device are isolated against each other and against the power supply with at least 500 V. Furthermore, CAN 1 has a separation voltage of up to 5 kV conforming with IEC 60601-1.

3 Operation

3.1 Initial Steps

To integrate the PCAN-Router DR into a CAN network, proceed as follows:

1. Mount the PCAN-Router DR at the appropriate position on the DIN rail by hanging it in at the top of the rail and snapping it to the bottom.
2. Connect each of the two CAN ports with the corresponding CAN network. If the bit rate is different from the default 500 kbit/s, set the bit rate with the rotary switch (see section 3.3 on page 11). The new bit rate takes effect after reset (see section 3.6 on page 13).
3. Connect the PCAN-Router DR to a power supply (8 to 30 V DC).

The PCAN-Router DR now forwards the CAN messages one on one.

3.2 Status LEDs

The PCAN-Router DR has several status LEDs. Using the standard firmware, the LEDs have the following meanings:

LED	State	Meaning
Status	Off	No CAN communication
	Green blinking	Operational
	Red flashing once	Reset
CAN 1/CAN 2	Green blinking	Data is transmitted
	Red flashing once	Communication error (error frames)
Power	Green on	Power supply is present

3.3 Rotary Switch Bit Rate

Using the rotary switch of the PCAN-Router DR, the CAN bit rate can be adjusted. The selected bit rate applies to both CAN channels. At delivery, the switch is set to C (500 kbit/s). A changed setting takes effect after the reset of the device (see section 3.6 on page 13).

Figure 6: Rotary switch for the bit rate

Switch position	Bit rate
0 (left)	5 kbit/s
1	10 kbit/s
2	20 kbit/s
3	33.3 kbit/s
4 (top)	47.6 kbit/s
5	50 kbit/s
6	83.3 kbit/s
7	95.2 kbit/s
8 (right)	100 kbit/s
9	125 kbit/s
A	200 kbit/s
B	250 kbit/s
C (bottom)	500 kbit/s
D	800 kbit/s
E	1 Mbit/s
F	CAN bootloader

On **switch position F**, the CAN bootloader is activated after a reset. In that way, you can upload a self-developed firmware via CAN to the device (see chapter 5 Firmware Upload on page 17).

3.4 CAN Termination

The termination for each CAN channel can be separately activated with switches on the board. At delivery, the termination is switched off. A High-speed CAN bus (ISO 11898-2) must be terminated on both cable ends with 120 Ω. Otherwise, malfunctions may arise.

If a can bus is not terminated correctly, activate the internal termination for the corresponding channel.

➥ Proceed as follows to change the termination setting:

Important note: Before opening the device, disconnect it from the power supply.

1. Open the plastic casing by slightly pushing the latches at the top behind the CAN 1 connector and at the bottom behind the power connector, e.g. with a flat tip screwdriver.
2. Pull out the circuit board including the casing front.

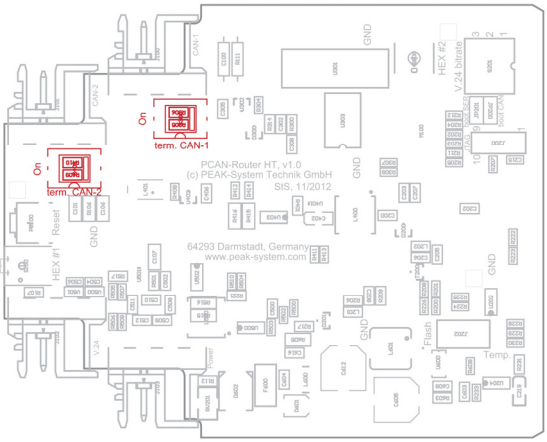


Figure 7: Switch on the circuit board for the termination of the CAN channels

3. Change the termination settings for the CAN channels using the switches on the circuit board. The affiliations and settings are labeled on the board.
4. For the assembly of the PCAN-Router DR, slide the board including the front part back into the plastic casing and press the casing together until the latches click in.

3.5 Signal Delay

The signal delay at forwarding of a CAN message consists of a fixed processing time of the microcontroller of about 30 µs and a variable delay depending on message length and transfer rate. Thus, the signal delay of a CAN message with an 11-bit ID and eight data bytes at 500 kbit/s is about 260 µs.

3.6 Reset Push Button

The reset button is located on the front of the PCAN-Router DR. To perform a reset, press into the small hole with the tip of small screwdriver or a paper clip.

If the PCAN-Router DR, for example, should be operated with a changed bit rate, it will take effect only after a reset.

Figure 8: Reset button

4 Programming Software

This chapter covers the installation of the Yagarto GNU ARM toolchain and gives notes about the software library and the firmware examples.

Software, source code, and additional information are included on the supplied DVD in the following directory branch:

`/Develop/Microcontroller hardware/PCAN-Router DR/`

4.1 Installing the GNU ARM Toolchain

To compile the code examples and the custom firmware code under Windows, install Yagarto on your computer. Yagarto is a collection of tools to develop applications for ARM processors and microcontrollers on Windows platforms. The collection includes the GNU GCC compiler for C and C++, Make, and further tools. Further information about Yagarto: www.yagarto.de

System requirement: Windows 8, 7, Vista (32/64-bit)

Do the following to install Yagarto:

1. From the directory branch on the provided DVD mentioned above, change to the `Compiler` subdirectory.

   The directory contains the two installation programs `yagarto-*.exe` and `yagarto-tools-*.exe`.

2. Execute the first installation program and follow its instructions.

   If you don't want to use the default destination folder, make sure that your customized path doesn't contain any spaces. Otherwise compile operations will not work later.

3. Afterwards, execute the second installation program and follow its instructions.

In the system environment, the installation programs create search paths for the executable files. These new search paths are effective only for programs and command prompts that are started afterwards.

4.2 Library

The development of applications for the PCAN-Router DR is supported by the library `libPCAN-Router-DRGNU*ys.a` (`*` stands for version number), a binary file. You can access all resources of the PCAN-Router DR by means of this library. The library is documented in the header files (`*.h`). The files are located in each example directory.

4.3 Firmware Examples

On the DVD, the `Example` subdirectory contains source code for several firmware examples that you can use and test directly and that you can reuse for custom firmware.

Note: The standard firmware that is installed at delivery is not available as source code. It is located as binary file in the `Standard firmware` directory.

4.3.1 Compiling a Firmware Example

Do the following to compile a firmware example under Windows:

1. From the provided DVD, copy the subdirectory of the desired example from the `Example` directory to the local hard disk.
2. Open a **command prompt** by using the Windows Start menu. Alternatively you can press the key combination ⊞ + R and enter `cmd.exe` as program to be executed.
3. At the command prompt change to the previously copied directory.
4. Execute the following command in order to clean-up the target directories (i.e. `.out`) from files that have been generated earlier:

   ```
   make clean
   ```

5. Execute the following command to compile the firmware example:

   ```
   make all
   ```

   If the compiler has finished without errors (“Errors: none”), you can find the firmware file with the extension `.bin` in the subdirectory `.out`. This file is then used for firmware upload to the PCAN-Router DR.

5 Firmware Upload

You can transfer (upload) a new version of the standard firmware as well as custom firmware to the PCAN-Router DR. The upload of firmware to the Router is done via a CAN bus with the provided Windows program PCAN-Flash.

➡ Go through the following sections for a firmware upload.

5.1 System Requirements

The following prerequisites must be given, so that the PCAN-Router DR can be updated with new firmware:

- CAN interface of the PCAN series for the computer (e.g. PCAN-USB)
- CAN cabling between the CAN interface and the PCAN-Router DR with proper termination (120 Ω on each end of the CAN bus)
- Operating system Windows 8, 7, Vista (32/64-bit)

5.2 Preparing Hardware and Software

For an upload of new firmware via CAN, the CAN bootloader must be activated in the PCAN-Router DR. This is done with the rotary switch on the front of the device.

Furthermore, as part of the preparations a CAN connection must be established and software must be copied from the provided DVD.

- Perform the following steps for preparation of the hardware:

  1. Switch the PCAN-Router DR off by disconnecting it from the power supply.
  2. Make a note of the current setting of the rotary switch “Bitrate” and then turn it to “F” (one notch below 0).
  3. Connect CAN connector CAN 1 of the PCAN-Router DR with a CAN interface connected to the computer. Pay attention to the proper termination of the CAN cabling (2 x 120 Ω).

     Uploading firmware via CAN connector CAN 2 on the PCAN-Router DR is not possible.

- Perform the following steps for preparation of the software:

  1. On the supplied DVD, change to the following directory: `/Develop/Microcontroller hardware/PCAN-Router DR/`
  2. Copy the subdirectory `PcanFlash` to the local hard disk.

     The contained Windows software that copies the Firmware via CAN (`PcanFlash.exe`) can only be started from a data carrier that is writable.

5.3 Uploading the Firmware

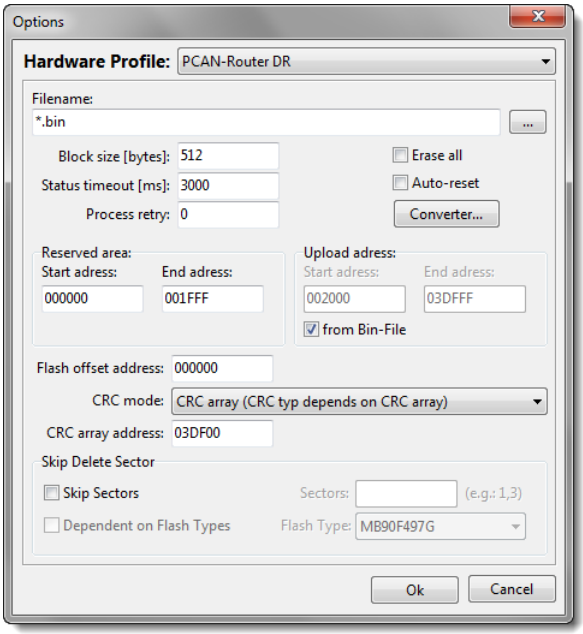
- The process of uploading new firmware to the PCAN-Router DR is as follows:

  1. Switch on the PCAN-Router DR by applying a supply voltage.

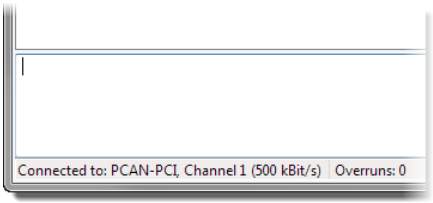
     The activated bootloader is indicated as follows:

LED	State
Status	off
CAN 1	orange blinking
CAN 2	orange on

2. Run the program `PcanFlash.exe` under Windows from the local hard drive.
3. Click on the (Options) button in order to call up the dialog box.
4. From the **Hardware Profile** dropdown list, select the **PCAN-Router DR** entry.

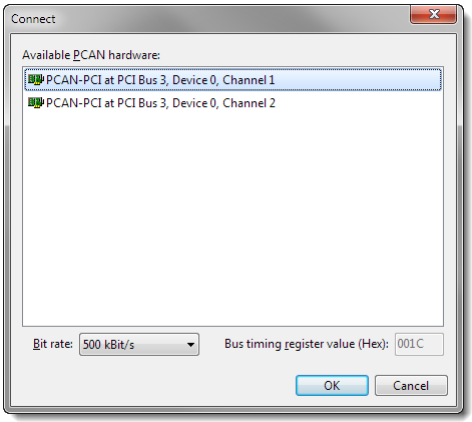


5. Click on the ... button next to the **File name** field in order to select the desired firmware file (`*.bin`) to be uploaded.
6. Click on the **OK** button.
7. Make sure that the PCAN-Flash program is connected with 500 kbit/s to the available CAN interface at the computer.



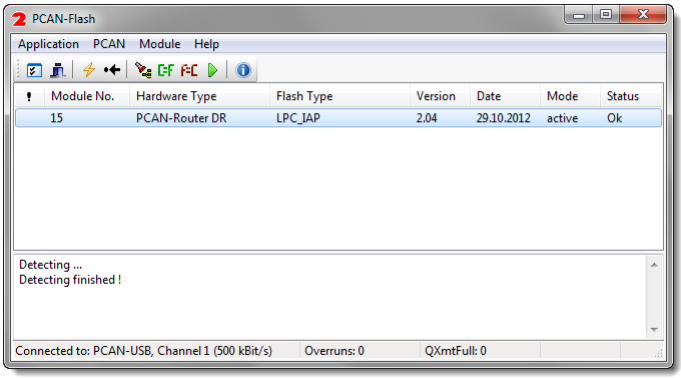
PCAN-Flash: Display of a connection in the status bar on the bottom.

If not, click the (Connect) button in order to change the selection in the according dialog box.



8. Click the (Detect) button in order to detect the PCAN-Router DR connected to the CAN bus.

   An entry for the PCAN-Router DR appears in the main window.



9. Select the entry for the PCAN-Router DR.
10. Click the ▶ (Program) button in order to start uploading the new firmware to the PCAN-Router DR.

    Observe the status indication at the bottom of the window. The process was successful if the last message to appear is “Flashing of module(s) finished!”.
11. Disconnect the power supply from the PCAN-Router DR.
12. Turn the “Bitrate” rotary switch back to the previously noted setting.

You can now use the PCAN-Router DR with the new firmware.

6 Technical Specifications

Connectors	
CAN	2 x Phoenix connector[1] 4-pin
RS-232	Phoenix connector 4-pin
Power	Phoenix connector 4-pin

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (Standard format) and 2.0B (Extended format)
Bit rates	5 kbit/s - 1 Mbit/s
Transceiver	NXP PCA82C251
Galvanic isolation	CAN 1 is isolated up to 5 kV against CAN 2, RS-232, and the power supply (compliant with IEC 60601-1) CAN 2 and RS-232 are isolated with 500 V against each other and against the power supply
Termination	Switchable for each CAN channel, disabled at delivery

Power supply	
Supply voltage	8 - 30 V DC
Current consumption	approx. 110 mA at 12 V

Measures	
Size	22.5 x 99 x 114.5 mm (W x H x D) See also dimension drawing in Appendix B on page 25.
Weight	101 g

[1] Phoenix connector, type MSTB 2,5/4-ST BK, order no. 1756298, www.phoenixcontact.com

Environment	
Operating temperature	-40 - +85 °C (-40 - +185 °F)
Temperature for storage and transport	-55 - +125 °C (-67 - +257 °F)
Relative humidity	15 - 90 %, not condensing
EMC	EN 61326-1:2013-07 EC directive 2004/108/EG
Ingress protection (IEC 60529)	IP20

Appendix A CE Certificate

PCAN-Router DR IPEH-002213 – EC Declaration of Conformity
PEAK-System Technik GmbH

Notes on the CE Symbol CE

The following applies to the "PCAN-Router DR" product with the item number(s) IPEH-002213.

EC Directive This product fulfills the requirements of EU EMC Directive 2004/108/EC (Electromagnetic Compatibility) and is designed for the following fields of application as for the CE marking:

Electromagnetic Immunity/Emission
DIN EN 61326-1, publication date 2013-07
Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements (IEC 61326-1:2012);
German version EN 61326-1:2013

Declarations of Conformity In accordance with the above mentioned EU directives, the EC declarations of conformity and the associated documentation are held at the disposal of the competent authorities at the address below:

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64293 Darmstadt
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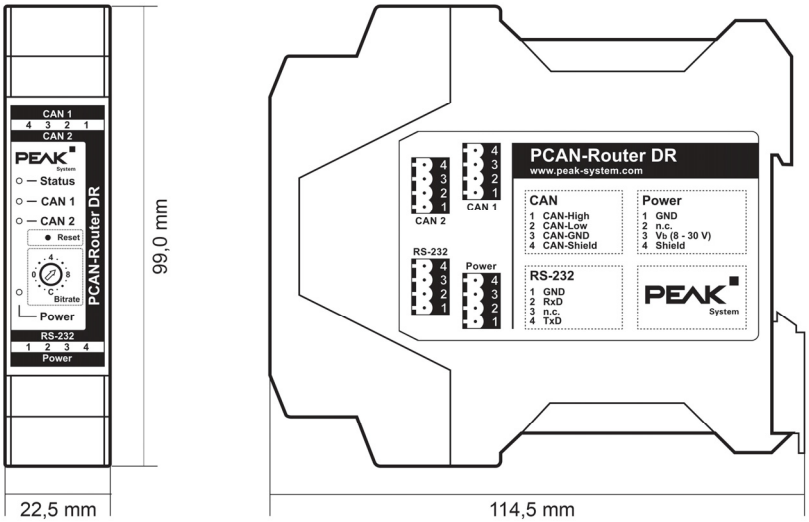
E-mail: info@peak-system.com

Signed this 22nd day of October 2013

Appendix B Dimension Drawing



The figure does not show the actual size of the product.